THE FATE OF *HELIOTHIS PELTIGERA* D. & S. IN SUSSEX.

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From the earliest of times this migratory moth has been known in England, although it was usually rare. Records came mainly from along the south coast, but when larvae were found they often occurred in abundance on a variety of different foodplants – probably largely on *Ononis repens* and *Senecio viscosus* (Restharrow and Sticky Groundsel). Nevertheless, despite the profusion of larvae when found, the adult insect was even during the halcyon days of the 19th century "for some unexplained reason . . . . rarely seen" (Barrett).Breeders soon found that an enhanced temperature, compared to the British Isles, of about 30 degrees Centrigrade sometimes yielded good results, and during the second world war Kettlewell (1944) conducted the still famous series of experiments, using this temperature to investigate the effects on pigmentation in imagines and the preceding pupal reactions. Nevertheless, the successful breeding of *H.peltigera* has far from consistently been achieved, even in recent times – the reason being undetermined.

On August 12th 1980, larvae were again discovered near Eastbourne, by Bernard Skinner, this always being a favoured area. As previously, local enthusiasts encountered varying degrees of success when breeding through to the adult stage; whilst some lepidopterists bred fine series by raising the temperature to 26 or 38 degrees Centigrade, others, using a more British lifestyle, experienced a high mortality rate with many cripples – and some failed completely. The success rate for larvae bred indoors with a temperature of 12 to 15 degrees Centigrade was up to 15%.

The larvae found in mid August were almost full grown and the previous stage had therefore been deposited, presumably by a primary immigrant, during June – although an adult was noted seven miles away at Ninfield on April 10th. All being well, it was expected that adults would emerge from the shingle in early October, but several visits with mercury vapour light were to prove fruitless. Nevertheless, according to Bretherton and Chalmers-Hunt (1981), there is evidence to suggest that at least one adult successfully completed its life-cycle on English soil during this summer – at Looe Bar in East Cornwall. At the time he wrote his article, Kettelewell thought the species established in southwestern England but at the present, despite some sequential records in Sussex (Pratt, 1981) and elsewhere, the insect is thought unable to withstand our winter climate. Therefore it was expected that when larvae encountered our winter weather death would be the result – but not in the manner described later.

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During the autumn, larvae were again found very commonly in the same place as previously, and to my knowledge a total of almost 250 caterpillars were taken by various collectors from this one spot at this time. On October 4th 1980, my wife and I collected 51 variable larvae during an hour, from a band of Sticky Groundsel growing on the sea-shore at the soon to be built upon area near Eastbourne. Buckler (1895) illustrates six larval forms (Vol. 6:Plate 99:2 to 2e) of which only one was not noted on that day – 2b. One parasite cocoon was soon discovered, with its hosts skin, attached to the foodplant; this emerged on October 17th into a fine Ichneumonid of the subfamily Campopleginae.

The caterpillars collected were in various stages of growth; 17 were in their final instar, 18 at the penultimate, and 15 were only one centimetre in length. Ten larvae in the penultimate instar were replaced outside at my home address, under net, on Marigold and Sticky Groundsel. All commenced feeding on the leaves, flowers, and seed heads. After two weeks had elapsed, five had apparently pupated, but by the time another similar time period had elapsed, the remaining half had died. These larvae were found hanging from a pair of abdominal legs and exhibited brownish/black discoloured blotches on their bodies, giving the appearance of small localised burns and singes. This syndrome was also present on the hairs and feet and could be seen a few days before death. No odour was discernable at this stage, although later an offensive smell was present; this was probably due to a secondary bacteriological attack and was determined as a gram negative rod type bacteria. Other obvious characteristics of the syndrome included a fragile skin and liquified contents.

A month later, on November 29th, the earth was carefully investigated for the remaining insects. Of the five larvae to go below ground only one had attained the pupal stage; this pupa was shiny black, very fragile, and contained myriads of pale white nematode worms, 0.55 mm in length. The other four larvae had died before pupation and had succumbed to the symptoms described earlier. Thus, none of this group survived outside, although all apparently continued to feed and live normally for some time after experiencing a night temperature of minus two degrees Centigrade six days after collection. According to Sacharov (1930), larval death in lepidoptera due to cold (as opposed to starvation due to prolonged immobilisation) is largely dependant upon the amount of fat present in individuals; this, and body salts, considerably lowering the freezing point of skin contents.

From the 51 larvae brought home, the remaining 40 were kept indoors and placed in an environment at a steady 19 to 20 degrees Centigrade. Sufficient water was added to the potted Marigold and Sticky Groundsel to ensure plant health but, that apart, a dry environment was aimed for. Two early instar larvae died after a week had elapsed, but by the 19th October, all the

rest had apparently pupated. Emergences commenced four weeks later on the 17th November, and continued through until 1st December, by which time 10 adults had been noted. Of these, three dark males and three dark females emerged successfully, whilst four failed to inflate their hindwings.

The earth from which these adults had emerged was then investigated for the remainder of the brood. All had attained the pupal stage, but 16 suffered from similar symptoms as those larvae placed outside – namely a liquifying of body contents. However, the insects had been well advanced to emergence as post mortems revealed several recognisable features, including antennae and wing scales. All 12 remaining pupae were still quite green, alive, and seemingly healthy at this stage.

Once these rather distinctive larval and pupal mortalities commenced, after consulting the illuminating section dealing with insect diseases, in volume 1 of *British Moths and Butterflies* by Rivers (1976), a virus disease was suspected. For confirmation, samples were forwarded to the National Environment Research Council's Institute of Virology at Oxford where Mr. C. Rivers kindly arranged for their examination. His report confirmed that a nuclear polyhedrosis virus (NPV) was responsible for the deaths and perhaps also the high proportion of cripples -- certainly, according to Neilson in Canada, the effects of a virus infection on adults can include wing cripples as experienced by the author and by Kettelewell nearly 40 years ago.

The virus was very similar to that used in America as a pest control measure for *Heliothis* species, it being extremely infectious, and was thought may be present as an attenuated infection in many individuals within a species but that a lowering of resistence is needed to allow multiplication and therefore to incur overt, and life-affecting, symptoms. This lowering of resistence would be precipitated by any adverse conditions met with and in the case of *H. peltigera,* as the species is at a speculative best at the edge of its range in England (failure to survive our winter being much more likely), our climate would surely provide just such a set of unsuitable circumstances.

Over the weeks following the adult emergences, three pupae dried up and another became distended with liquified contents; also, at the end of January, a white fungus started to attack three further pupae, sending up vertical columns of excrescence quite a centimetre in height. By the middle of February, although five pupae were still healthy, it seem likely that no further emergences would be forthcoming in the short term, unless a different approach was made. Kettlewell encountered this in his experiments, and stated that some pupae derived from Kent, had to experience a previous period of cold before the application of heat became successful – this being attributed to a hibernatory phase. The remaining five pupae were therefore placed in a domestic refrigerator at 7 to 8 degrees Centigrade for 5 weeks, and then incubated at 26 to 28 degrees Centigrade over damp sand. All pupae survived the artificial

winter, and after just over a month had elapsed at the higher temperature, these five final survivors suddenly coloured up. Two very light coloured females emerged on April 26th, but the last three pupae died containing millions of microscopic polyhedra characteristic of a NPV. Even these two final emergences were not completely free of the crippled hindwing symptoms noted earlier, although this was now minimal.

Summary

Inconsistency has always dogged the breeding of *H.peltigera* in Britain, both in the wild and by collectors, with often unexplained high mortality rates; having regard to the causes of death found in feral larvae from Sussex in 1980, it is postulated that in addition to the more usual hazards encountered, NPV's have always accounted heavily for this phenomenon – especially as traces of some pathogenic micro-organisms can remain infectious for many years under certain conditions.

Attempts by others to breed the species through, using the same stock, at temperatures of 26 and 38 degrees Centigrade enjoyed a near perfect success rate. However, of 40 larvae placed in an artificial environment at 19 to 20 degrees Centigrade, 65% showed severe symptoms of, or eventually died from, the presence of a NPV; 15% either dried up or succumbed to fungal attack in the pupal stage; whilst 20% attained the adult state successfully. Total lethality was experienced by collected larvae, which continued to be exposed to the "normal" autumn conditions encountered on the Sussex coast in 1980; excluding a single mortality due to the presence of nemotodes, all died from the symptoms of a NPV.

Thermal inhibition of NPV's, on a very similar temperature range, in some insects was noted more than 25 years ago by Bird (1954), and later by Tanada and Tanabe (1965), and others. Whilst larvae survived temperatures below the freezing point of water, low temperature seemed to be the main factor allowing virus multiplication.

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References

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